DISTRIBUTION SYSTEM RELIABILITY IMPROVEMENT USING DISTRIBUTED GENERATORS.

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Dedicated To My Beloved Father and Mother

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In the name of Allah, the Most Gracious and the Most Merciful

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ABSTRACT

Solar Energy is one of alternative source for rural electrification where no nearest grid connected available. However, since it is only depending on sun irradiation it only can feed customers need during day time only. Besides, a standalone solar energy cannot provide a continuous supply due to seasonal weather and any other periodic variations. Therefore, to satisfy the customer needs, a hybrid energy source is a better solution. A combination between solar PV with Battery and Generator set proposed as the hybrid energy source called Hybrid Distributed Generator. Investigation will be done on reliability improvement for Distribution system by using this Distributed Generator. Distributed Generator installed at Station Solar Hybrid in Tanjung Labian will be investigate. The SAIDI used as the Indices to show the reliability improvement for distribution system. SAIDI is an importance where continuity of power is high priority. Besides, SAIDI contributes the amount of time the customer is affected without power supply.

ABSTRAK

Tenaga solar merupakan salah satu diantara tenaga alternatif untuk digunakan sebagai tenaga elektrik yang akan membekalkan bekalan elektrik luar Bandar yang mana kemudahan talian grid terdekat tidak terdapat di kawasan tersebut. Walaubagaimanapun, oleh kerana tenaga solar ini bergantung sepenuhnya kepada sinaran solar maka ia hanya dapat menampung beban pengguna pada hari siang. Disamping itu, tenaga solar sahaja tidak dapat menyambung bekalan elektrik secara berterusan disebabkan factor perubahan cuaca dan apa – apa variasi berkala. Oleh itu, untuk memuaskan hati kehendak para pengguna, sumber tenaga hibrid adalah penyelesaian yang lebih baik. Gabungan antara tenaga solar dengan batteri dan set penjana dicadangkan sebagai sumber tenagan hybrid yang dipanggil penjana pengedar. Penjana pengedar yang dipasang di Stesen solar hybrid di Tanjung Labian akan di siasat. SAIDI akan dijadikan kayu pengukur kebolehpercayaan sistem pembahagian menggunakan tenaga dari penjana pengedar. SAIDI ini penting dimana ia kesinambungan bekalan yang berterusan adalah keutamaan yang tinggi. Selain itu, SAIDI menyumbang jumlah masa pelanggan yang terjejas tanpa bekalan kuasa.

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LIST OF SYMBOLS AND ABBREVIATIONS

UTHM	-	Universiti Tun Hussein Onn Malaysia
kW	-	KiloWatt
km	-	Kilometer
PV	-	Photovoltaic
DG	-	Distributed Generator

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Project Background

Distributed generation is a new approach in electrical industry [1] and has been gradually increasing in the last few years and will rise even more in near future [2].

Due to high power demand, Utility such as Sabah Electricity Sdn Bhd (SESB), Tenaga Nasional Berhad (TNB) and Sarawak Energy Berhad (SEB) are continuously planning the expansion of the electrical networks. One of the methods used for the expansion of electrical networks is connecting distributed generator in the distribution system [3].

Distributed Generators is defined as a small-scale generation unit connected at or near the customer load. The technologies for Distributed Generators are based on reciprocating engines, photovoltaic, fuel cells, combustion gas turbines, micro turbines and wind turbines. This technology is also known as alternative energy system [4].

By connecting distributed generators in the distribution system, the power demand of the system can be satisfied and also improves the reliability of the electrical network [3].

Reliability is not a new topic in electric power industry. Yet, it has attracted interest of professionals in the past decade due to incessant blackouts being experienced [5].

In US, Distributed Generator uses as a sustainable and competitive form of generation, not just restricted to renewable energy. In light of the recent blackout in New York, it is proposed as a significant part of the solution to improve both security and reliability of supply, with islanded operation of distributed generation on microgrids a real prospect for the future. However, in Europe, it is viewed more renewable generation, which is given priority dispatch and should be accommodated where possible [6].

Most independent Distributed Generator such as photovoltaic (PV) as a generator, weak in stability and sustain the power supply since the source are mostly dependent on weather condition. Thus, a hybrid Distributed Generator is a solution. It is more practical and stable since it is based on more than one energy source. Besides, this hybrid system is suitable to use in remote areas with no access to utility grid.

In this project, Hybrid Distributed generators installed at Station Solar Hybrid Tanjung Labian, Lahad Datu Sabah will be explored. Construction of this project started on October 2011 and the system commissioning on December 2012. This Station is not connected to an integrated power network. The networks which are not connected power network constitute an isolated power system. The network currently supplies 24 hour electricity to 681 household. Figure 1.1 showing rural electrification using distributed generator for highlighted village.

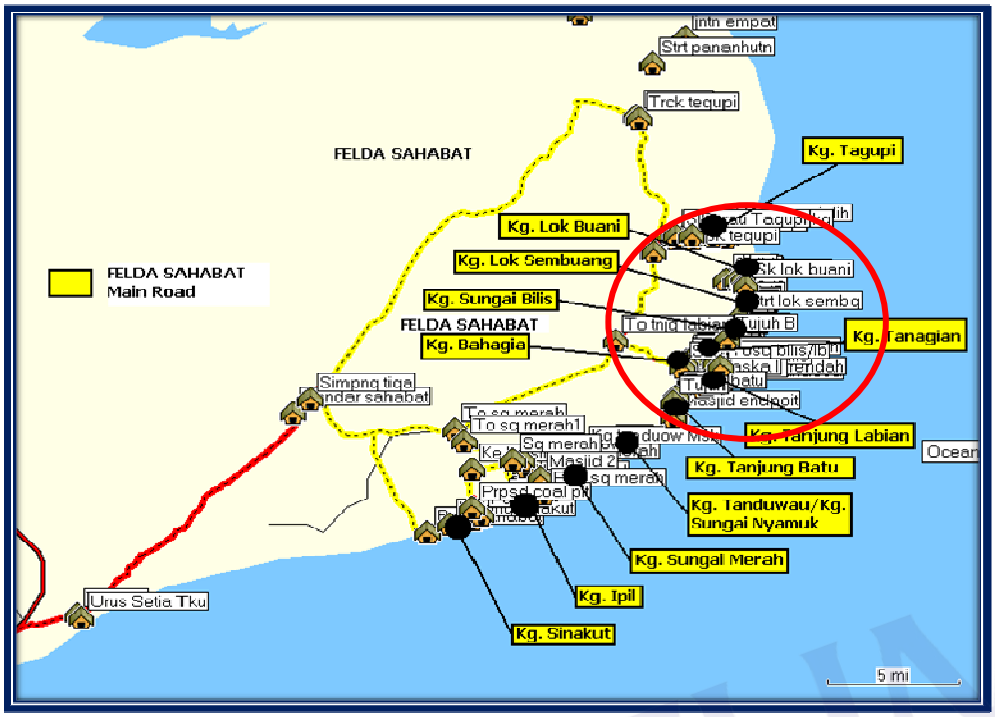

Figure 1.1: Rural Electrification : Tanjung Labian Lahad Datu, Sabah

For this station, a hybrid Distributed Generator system development using solar photovoltaic (PV) combined with fuel generator and battery storage systems used to serve the village. Reliability of the system can be examined by using development software called MATLAB/SIMULINK program where this program will show the reliability impact of Distributed Generator. Figure 1.2 shows the connection of the Distributed Generator install at Station Solar Hybrid Tanjung Labian. The single line diagram of distribution system is shown in Figure 1.3.

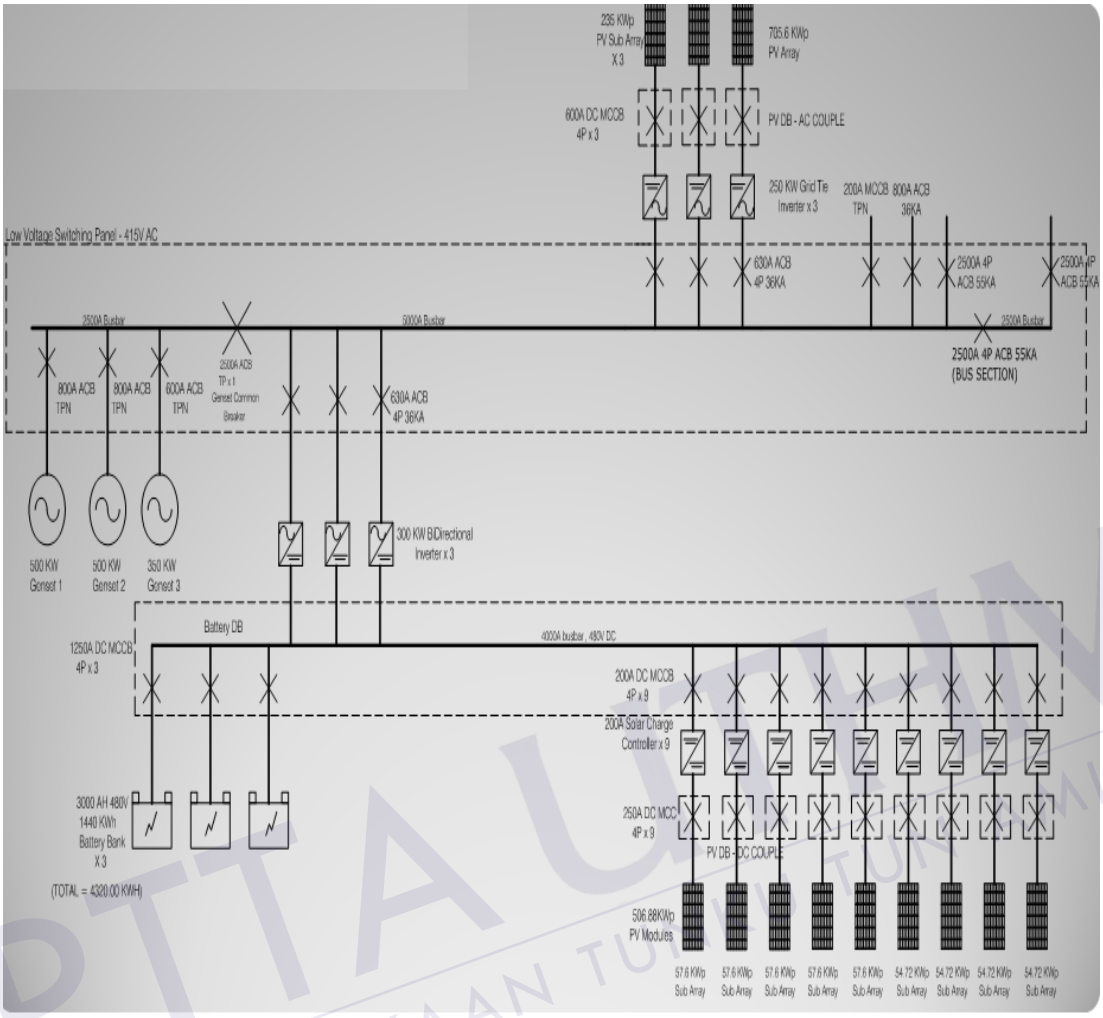

Figure 1.2: Distributed Generator connected at Station Solar Hybrid Tanjung Labian, Lahad Datu, Sabah

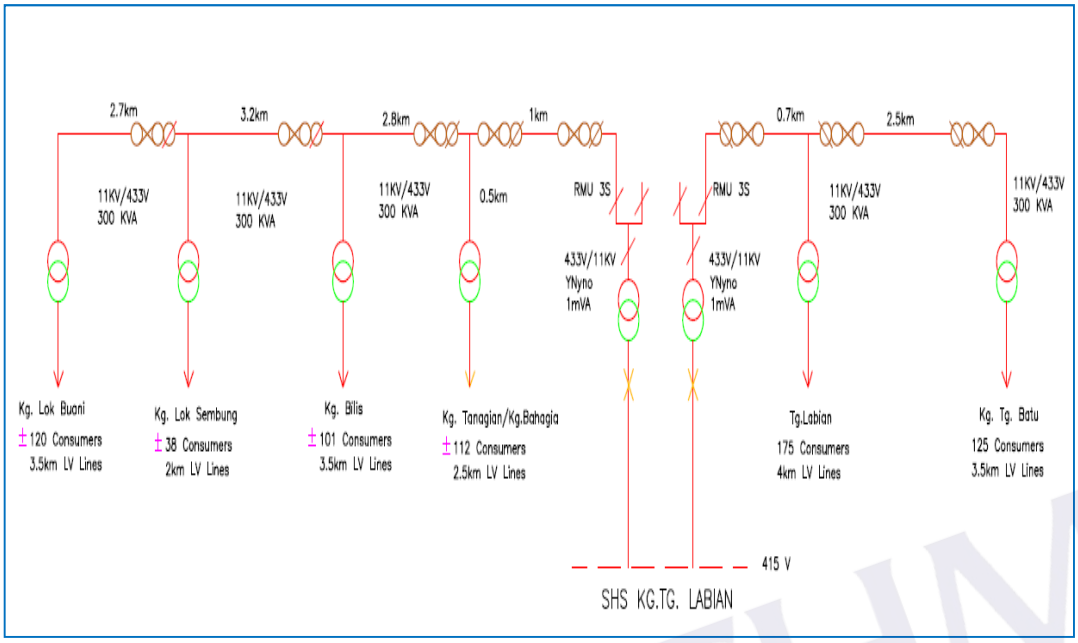

Figure 1.3: Single Line diagram of Tanjung Labian Lahad Datu, Sabah

1.2 Problem Statements

Nowadays, the electric power industry is facing huge changes with respect to structure, function, and regulation [3]. The use of distributed generators within distribution network has drawn attention due to several advantages that small scale generation can potentially provide to power utilities. The distributed generation has created a new way for the electric power generation. [3].

The electric power generation that is integrated within the distribution system is called distribution generation [3]. It is a new approach in electrical industry [1]. In order to achieve both reliability cost and worth requirement to the company, a study has been done to select a best possible location for distributed generators.

Thus, a lot of things need to be considered for installing distributed in distribution system such as impact on power flow, voltages, and reliability indices, which could be positive or negative [3]. Therefore, maintaining a reliable power supply is a very important issue for power system design and operation. At planning stage they faced by difficult problem of deciding how far they are justified in increasing the investment on their facilities to improve service reliability [6].

Electric demands from rural areas such as Gugusan Tanjung Labian Lahad Datu Sabah attract Government Malaysia to expand the electrical network to that area. Thus, Government appoint the consultant to make the survey on how the electricity can be bring in to the proposed location. Tanjung Labian is situated between 5° and 10° in North Latitude and 119° and 14° in East Longitude. Figure 1.4 indicates the location of Tanjung Labian Lahad Datu Sabah.

Figure 1.4: Sabah Map: Location of Tanjung Labian Lahad Datu, Sabah

Time constrain versus high demand bring the system are not centrally planned and dispatch since this is direct negotiation project between Contractor and Government Malaysia. Distributed Generation install in Tanjung Labian Lahad Datu is taken as a case study. Estimates of the Station Tanjung Labian renewable energy resource and actual system data are employed to assess the impact of Distributed Generated connection.

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1.3 Project Objectives

General aim of this project is to evaluate power system reliability improvement using Distributed Generators installed in Station Solar Hybird Tanjung Labian, Lahad Datu, Sabah

The objectives of this project are:

1. To measure the characteristic such as Generator mode, Photovoltaic mode and battery mode during normal and super peak condition of Distributed Generator.

2. To investigate reliability on Station Solar Hybrid, Tanjung Labian by analyze the performance of existing Station Solar Hybrid, Tanjung Labian.

3. To perform reliability assessment on a distribution system circuit based on different location of Distributed Generator.

4. To suggest possible location of Distributed Generator for highly distribution system in Tanjung Labian.

1.4 Project Scope

The Scopes of this project are:

1. The study will be conducted at Station Solar Hybrid Tanjung Labian Lahad Datu, Sabah.

2. The Capacity Electric Power Installed at Station Solar Hybrid Tanjung Labian Lahad Datu to be investigate

(i)	Engines Diesel installed	Two (2) unit 500KVA One (1) unit 350kVA
(ii)	Fuel Cell or Battery installed	Capacity 4320kWh
(iii)	Inverter System installed	900kW Bi-Directional Inverter 750kW 'Inverter & Control System'
(iv)	Photovoltaic Panel installed	Capacity 1.2MW

3. Village Coverage and Station Solar Hybrid Tanjung Labian Lahad Datu Sabah as a Measurement.

No	**Village Name**	**No of Houses**	**Load Demand (kW)**
1	Kg. Tg. Labian	175	197
2	Kg. Tg. Batu	125	140
3&4	Kg. Tanagian dan Kg. Bahagia	122	137
5	Kg. Sg. Bilis	101	114
6&7	Kg.Lok Sembuang dan Lok Buani	158	178
	Total	**681**	**766**

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the operation or method of the Distribution system using Distributed generator will be revealed so that this project could be understood easily.

2.2 Theories

Figure 2.1 shows the block diagram or engine of Rural Electrification for Tanjung Labian Lahad Datu, Sabah. It was made up of three main parts which are Distributed Generator, Operational Factor and Software. The Distributed Generator used to produce any electric power to the consumer of Tanjung Labian. Once electric power produce, a lot of Operational Factor need to consider and a research using MATLAB/SIMULINK software and one year data obtain from the station used to get the reliability analysis of the system as the Distributed Generator installed.

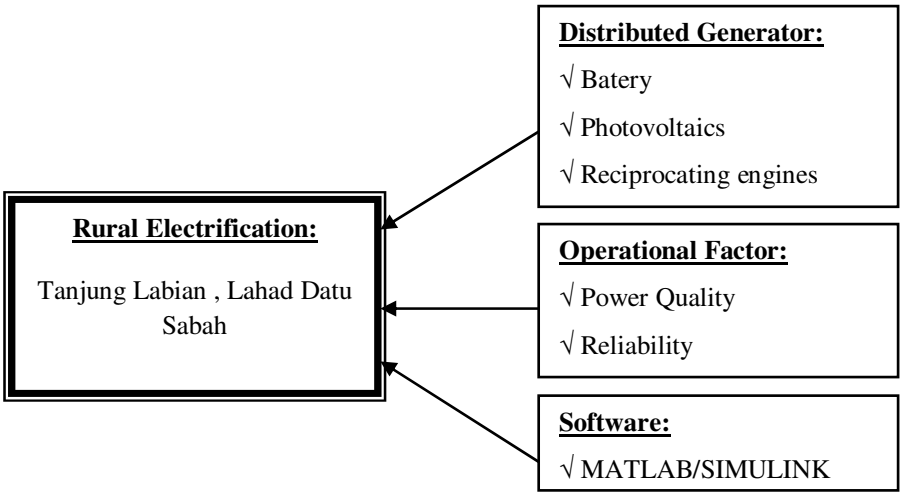

Figure 2.1: Rural Electrification : Tanjung Labian Lahad Datu, Sabah

2.2.1 Distributed Generations

Distributed generation (DG) is currently being used by some customers to provide some or all of their electricity needs. There are many different potential applications for Distributed Generators technologies. For example, some customers use Distributed Generators to reduce demand charges imposed by their electric utility, while others use it to provide primary power or reduce environmental emissions. Distributed Generators can also be used by electric utilities to enhance their distribution systems. Several energy sources drive distributed generators including:

2.2.1.1 Reciprocating engines

This Distributed Generators technology was developed more than a century ago, and is still widely utilized in a broad array of applications. The engines range in size from less than 5 to over 5,000 kW, and use diesel, natural gas, or waste gas as their fuel source. Development efforts remain focused on improving efficiency and on reducing emission levels. Reciprocating engines are being used primarily for backup

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